

FLOODPLAIN ECOSYSTEM RESTORATION: COMMODITY MARKETS, ENVIRONMENTAL SERVICES, AND THE FARM BILL

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Abstract: Economic and cultural values, the same forces that led people to alter floodplain ecosystems, will be the forces that determine the extent of their restoration. Landowner investment in agricultural production and forest and hydrologic restoration will reflect perceived economic returns from investments, as well as personal preferences for the environmental services each land use provides. Conservation programs and emerging environmental markets can encourage floodplain restoration, but will be effective only if they improve economic returns from bottomland management relative to other land uses. Over the past three years, prices for corn, soybeans, wheat, and other agricultural commodities have increased sharply, increasing returns to crop production and decreasing the amount of marginally profitable cropland, land most likely to be restored to bottomland hardwoods. Understanding commodity price dynamics is critical for understanding the potential for retiring cropland into bottomlands. Often Farm Bill conservation title provisions attract the greatest attention regarding bottomland hardwood restoration. However, the commodity title, which sets commodity price supports, and energy policy, need to be considered because commodity and energy policy effect returns from bottomland hardwood restoration.

Key Words: bottomland hardwood restoration, energy policy, markets

INTRODUCTION

We examine the role of the conservation title on bottomland hardwood restoration by placing it into the broader context of economic forces affecting farming and forestry. We discuss the historical forces that drove land-use change from bottomland hardwood (BLH) and other wetland ecosystems to agricultural use, and how these forces influence BLH restoration on marginally profitable agricultural lands. These forces include agricultural commodity prices, energy legislation, and agricultural programs (Claassen et al. 2004, Lubowski et al. 2006, Riley 2008), and were examined in the short and the long term to obtain a clearer understanding of the opportunities for wetland restoration and the role conservation programs can have in fostering these restorations.

This discussion provides economic explanations and motivations for wetland restoration. We examine BLH ecosystem restoration as a question of changing land-use, and examine the role of markets, legislation, and policy on the returns to land from a landowner decision-making framework. We recognize that BLH are a subset of floodplain ecosystems. However, discussing a specific system provides for a simpler dialogue.

We believe our comments can be extrapolated to other wetland systems but will leave that to others more familiar with those systems.

BLH restoration restores the environmental services provided by these ecosystems. The perspective we take is that as cropland is converted to BLH, the net flow of non-market environmental services such as nutrient cycling, carbon sequestration, and wildlife habitat from that land increases, reflecting the restoration of a set of environmental services from the pre-agricultural ecosystem (Faulkner et al. 2008). This net increase in services will be the basis of our closing comments regarding environmental services markets.

Several observations and broad concepts provide both a context and a foundation for examining bottomland restoration and the forces influencing the extent of this restoration.

1. Bottomland hardwood and other wetland ecosystems have declined in area since European settlement and have become increasingly fragmented; reducing the environmental services they provide (Faulkner et al. 2008, Kiem et al. 2008, Lockaby 2008).
2. Conversion to agricultural use has been the primary cause of the decline in the extent of

these ecosystems (Faulkner et al. 2008, Kiem et al. 2008, Lockaby 2008).¹

3. These conversions are the result of rational economic decisions by landowners in light of market conditions and incentives (US Department of Interior 1994, Busman and Sands 2002, Natural Resource Conservation Service 2002).
4. If BLH restoration occurs in the future, these conversions will continue to be the result of rational economic decisions by landowners. Further, previously converted agricultural lands will be the primary source of the restored wetlands (US Department of Interior 1994, Busman and Sands 2002, Natural Resource Conservation Service 2002).
5. All land provides a set of services. Changing land use on a parcel of land changes both the market returns and non-market environmental services provided by that land (Natural Resource Conservation Service 2002, Natural Resource Conservation Service 2008).

For most of U. S. history, BLH and other wetland ecosystems have been viewed as unproductive, while improved agricultural land has been highly valued (Dahl and Allord 1997). This point of view led to adoption of multiple public policies, such as preferential taxes, land grants, extension and technical assistance, public works projects, and commodity subsidies, designed to encourage landowners to convert swamps perceived as unproductive into productive cropland (Stavins and Jaffe 1990, Dahl and Allord 1997). These government policies have altered the net revenue generated by alternatives, and thus affected outcomes that result from rational decision making (Wu 1999, Goodwin and Smith 2003, Lubowski et al. 2006).

ECONOMICS OF LAND USE CHANGE

The most straight forward model for examining land conversion holds that BLH conversion to cropland occurs because landowners believe the investment from draining, clearing, and cultivating bottomlands will generate profits. This is a rational decision based on the calculation of whether expected returns from converted land (for crops, buildings, and other purposes) exceeded the cost of conversion plus the returns from the lands without conversion. While simple, this model suggests that, all other factors held equal, relatively productive

land tends to be converted first and increasing agricultural returns increases the likelihood of conversion (Lubowski et al. 2006).

It is important to emphasize that while the simple market returns framework explains much land change, it does not consider the role of landowner preferences, personal use of non-market amenities, uncertainty, risk preferences, different planning horizons, and other factors in landowner land use decisions. Non-market motivations such as personal consumption and preferences have repeatedly been demonstrated to play a role in landowner decisions regarding resource management (Leopold 1949, Hartman 1976, Hyberg 1987, Hyberg and Holthausen 1990, Lubowski et al. 2006). These non-market considerations are important explanatory factors in explaining individual decisions, but tend to be less important variables in explaining aggregated shifts in land use.

Increased risk, all other factors held constant, reduces investment, and has a negative impact on investment (Goodwin 1993, Wu 1999, Goodwin and Smith 2003, Gong et al. 2005). Agricultural prices are traditionally volatile, being sensitive to unanticipated shifts in supply and demand. Although markets adjust in the long run, price shocks make crop production risky. As risk for crop production increases options offering guaranteed annual payments become more attractive.

The simple model will be used to examine the role of commodity markets and energy policy on BLH restoration. We will then incorporate several non-risk considerations when discussing the role of conservation policy.

MARKET AND POLICY FORCES INFLUENCING WETLAND RESTORATION

We have identified four forces driving landowner decisions on BLH restoration. These forces, in order of relative impact are commodity markets, energy legislation, and the commodity and conservation titles of the new Farm Bill.

Commodity Markets

Since 2006, rising agricultural commodity prices have reduced landowner willingness to convert cropland to conserving uses. National farm prices for corn, soybeans, and wheat in 2005/06 averaged \$2.00, \$5.66, and \$3.42 per bushel, respectively (World Agricultural Outlook Board 2008b). In 2006/07, they increased to \$3.04, \$6.43, and \$4.26 per bushel and were at record highs, respectively, of \$4.20, \$10.10, and \$6.48 in 2007/08 (Table 1). Cash

¹ River and stream control measures by the Army Corps of Engineers have played a large role in bottomland hardwood conversion, but these are more permanent and unlikely candidates for restoration (Dahl and Johnson 1991, Dahl 2000, Dahl 2005).

Table 1. Prices (\$US/bu) for corn, wheat, and soybeans in the U. S. from 2005 through 2008. The prices for 2008/09 are forecasted (F). Source: World Agricultural Outlook Board November 2008.

	2005/06	2006/07	2007/08	2008/09 F
Corn	2.00	3.04	4.20	4.40
Soybeans	5.66	6.43	10.10	9.85
Wheat	3.42	4.26	6.48	6.85

and futures prices were well above the season-average farm level, ahead of spring planting, allowing farmers to ponder very attractive prices for nearly all crop choices. The 2008 USDA baseline forecast projects continued strong commodity prices for the foreseeable future (World Agricultural Outlook Board 2008a).

Rapidly increasing prices have had a dramatic impact on the value of agricultural production, which in turn had a large impact on returns to landowners who have land available for agricultural production. Between crop years² 2005 and 2006 rising prices for corn, soybeans, and wheat generated \$13.6 billion in additional revenue³ (Table 2). For the 2007 crop year, the market value increased \$35 billion. For the 2008 crop year revenues are forecast to increase another \$3.4 billion. The increased revenue from corn, wheat, and soybean production has led to a 5.5-million hectare increase in cropland planted nationally in these crops in just two years (Table 3).

The increased returns to crop production reduce land available for BLH restoration. A simple analysis can demonstrate the profound effect

Table 2. U. S. gross market revenues (\$ billion) for corn, wheat, and soybean 2005–2009. For 2008/2009, gross market revenues are forecasted (F). Source: National Agricultural Statistics Service November 2008, World Agricultural Outlook Board November 2008.

	2005/06	2006/07	2007/08	2008/09 F
Corn	22.2	32.1	54.9	52.8
Soybeans	17.3	20.5	27.0	28.8
Wheat	7.2	7.7	13.4	17.1
Total	46.7	60.3	95.3	98.7
Annual Change		13.6	35.0	3.4

² The crop year starts with the harvest and lasts for 12 months. Corn and soybeans use a September–August crop year, while wheat is June–May.

³ Additional revenue, the increased receipts from higher commodity prices, should not be confused with net revenue. Net revenue accounts for increased costs as well as increased revenue. This analysis does not account for increased costs of production after 2005 because updated costs are not yet available.

Table 3. Total area (in 1000 hectares) in the U. S. planted in corn, wheat, and soybean from 2006–2008. Source: National Agricultural Statistics Service November 2008.

	2006	2007	2008
Corn	31,698	37,879	34,758
Soybeans	30,563	26,198	30,707
Wheat	23,207	24,457	25,514
Total	85,468	88,534	90,979

commodity prices have on BLH restoration in the Mississippi Alluvial Valley (MAV). The analysis estimates the effect of soybean prices on the amount of marginally profitable soybean cropland, lands most likely to be considered for restoration, in MAV counties of Arkansas, Louisiana, and Mississippi. Marginally profitable soybean hectares in these States are estimated using the 10-year average county soybean yields as reported by USDA's National Agricultural Statistics Service (National Agricultural Statistics Service 2008). Using the 10-year average avoids having an exceptional year strongly biasing the estimate. The net return per hectare from soybean production at a given price is estimated using the average county yields and regional soybean cost of production estimates (Economic Research Service 2008) and varying farm prices. To estimate marginally profitable hectares,⁴ the net per hectare return in each county for each price was compared to the weighted average Conservation Reserve Program (CRP)⁵ soil rental rate for that county (Farm Service Agency 2008). If the CRP soil rental rate was greater than the estimated net return, half of the county soybean hectares were considered marginally profitable.⁶ Increasing the soybean price reduces the number of marginally profitable soybean hectares, as shown in Figure 1. This analysis ignores risk and non-market factors. If landowners are risk averse, then CRP would be more attractive because guaranteed annual payments are not subject to market and yield fluctuations that increase risk.

⁴ For this manuscript, marginally profitable hectares are the number of hectares planted to soybeans where expected revenue minus the operating costs is less than the annual rental payment from the CRP.

⁵ CRP soil rental rates are considered a reasonable measure of rental value for marginally profitable cropland because the CRP provides eligible landowners annual rental payments for establishing conservation cover and retiring cropland. Contracts run for 10 to 15 years, and also provide landowners with 50 percent or more of the cost of establishing the conservation cover.

⁶ This assumes that 50 percent of county hectares produced at or below the average county yield.

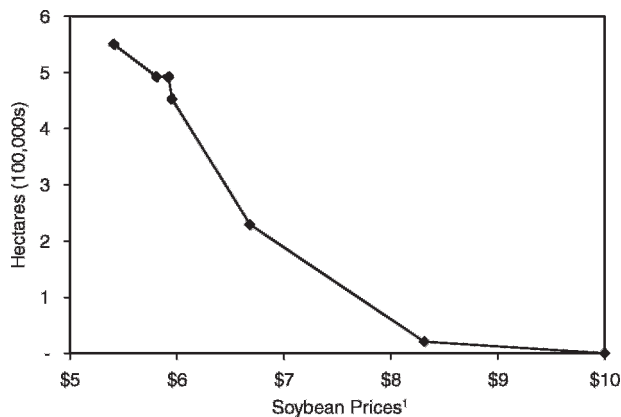


Figure 1. Total hectares of marginal soybean cropland for crop years 2002–05 and November 2007 (\$8.31) for portions of Arkansas, Louisiana, and Mississippi within the Mississippi Alluvial Valley.

¹ Soybean prices were based on the national price. Cropland was considered marginal if the expected revenue at a soybean price was less than operating cost.

Before the recent run up in prices, the four-year (2002–05) average soybean farm price was \$5.96 per bushel. The analysis estimates that at \$6.00 per bushel, 0.45 million soybean hectares are considered marginal. Conversely, there were only 20,000 hectares of marginally profitable soybean fields when the analysis was repeated using soybean prices observed in November, 2007 (\$8.31/bu). At \$10 a bushel, marginally profitable soybean hectares disappear.

Strong commodity markets signal that the opportunity cost for retiring cropland is high, and increases in planted hectares reduce wetland restoration on agricultural land, a primary source of restorable wetlands. The simple analysis above is supported by declining enrollment in USDA wetland restoration practices as commodity prices have increased (Table 4).

Energy Legislation

Fundamental questions include: “How long will high commodity prices continue?” and “What is the role of recent energy legislation on these prices?” We gain some insight by examining the forces driving the recent increase in crop prices. The list includes poor weather in major crop production regions of: Australia, Europe, and Ukraine; expanding world demand driven by rapid economic growth in China and India; escalating fuel and fertilizer costs; and recent U. S. energy legislation that has sharply increased demand for ethanol made from corn (Trostle 2008).

The current surge in agricultural commodity prices has similarities to previous price surges; the

Table 4. Total area (1000 hectares) of bottomland hardwood restoration in Arkansas, Louisiana, and Mississippi under the Conservation Reserve (CRP) and Wetland Reserve Programs (WRP) for 2005–2007. Source: Farm Service Agency 2008.

	2005	2006	2007
WRP	5.3	2.2	0.8
CRP ¹			
Riparian Buffers	9.4	8.1	7.1
Wetland Restoration	2.4	2.3	2.7
Bottomland Hardwood	2.6	4.7	3.3
Sub-Total	14.4	15.0	13.2
Total Bottomlands Restored	19.6	17.3	14.0

¹ In the Mississippi Alluvial Valley three sets of CRP practices are used to restore bottomland hardwoods. Columns may not sum exactly due to rounding.

adjustment of commodity markets over time to these shocks can provide a framework for developing expectations for adjustment to current market conditions. In the early 1970’s, the Soviet Union’s sudden and massive grain purchases triggered a period of very strong prices. However, prices receded as farmers increased production and global demand weakened with slower economic growth (Trostle 2008). Likewise, a spike in prices in the mid-1990’s was not sustained for long, due to a large global supply response and the Asian financial crisis. In both instances, the United States had a substantial pool of set-aside land⁷ available that allowed a rapid increase in crop production.

In 2008, record prices led to a large increase in world planted wheat area, which along with favorable growing conditions resulted in record forecast production, and wheat prices have softened. In the case of corn, however, U. S. and global production was already a record high in 2007, yet prices continued to soar in the face of strong demand, reflecting an increasing linkage between energy and agriculture. Much of this linkage is a result of energy legislation that supports corn demand and clearly affects land-use decisions.

Both the Energy Policy Act of 2005 (PL 109-58) and the Energy Independence and Security Act of 2007 (EISA, PL 110-140) have had a strong impact on commodity markets and land-use. The Energy Policy Act mandated that gasoline be blended with a minimum of 7.5 billion gallons of ethanol by 2012 and continued to provide tax incentives to blenders

⁷ Prior to the 1996 Farm Bill, U. S. commodity programs required participants to set-aside a percentage of their cropland when supplies were large as a condition for receiving program benefits. This ‘set-aside’ land was easily brought into crop production when commodity supplies tightened.

using ethanol. It also did not extend the limited liability protections for MTBE,⁸ rendering it no longer viable for use as a gasoline oxygenate. This further solidified ethanol's market.

The response to the 2005 act was immediate and strong. With no liability protection for MTBE, ethanol became the sole oxygenate for gasoline, lifting ethanol prices sharply and stimulating a large expansion in capacity. Ethanol output exceeded mandated targets and the increased demand for corn and higher corn prices brought a huge increase in corn hectares in 2007.

EISA was passed in December, 2007, only 27 months after the 2005 Act. The 2007 Act has numerous provisions, including: 1) it increased the mandate for blended ethanol to 36 billion gallons per year by 2022 (15 billion gallons of corn based ethanol, and 21 billion of "advanced biofuels" from non-corn starch sources such as cellulose), and 2) it defined acceptable cellulose biomass to include thinning and timber harvest slash, but to exclude "large timber operations."⁹

To put the 2007 Energy Independence and Security Act into context, it is important to consider current production and demand for ethanol. In 2007, the United States produced about 6.5 billion gallons of ethanol (Riley 2008). Currently, ethanol is primarily used in a 10-percent blend with gasoline. This blend is the maximum ethanol blend acceptable under most auto engine warranties. Without waivers on these warranties, new engine technologies, or much higher use of flex-fuel vehicles that can use E85 blends, the U. S. ability to use ethanol will be saturated at approximately 14–15 billion gallons (Riley 2008).

Additionally, EISA identifies cellulosic ethanol as the next energy technology, although no commercially viable cellulosic ethanol facility is currently operating, even with strong incentives. Some analysts have expressed concern over legislatively selecting the appropriate energy technology because other technologies may become feasible at \$100+ per barrel oil (O'Hare 2006, Furchtgott-Roth 2008). Markets in most cases provide a more effective solution than legislation (Coase 1960). Further, excluding large timber operations may create a barrier to some viable cellulosic technologies.

⁸ Methyl tertiary-butyl ether, better known as MTBE, was used as an additive to oxygenate gasoline to meet clean air requirements. MTBE had a lower cost than ethanol, and was therefore in broad use. Its use became a concern when MTBE was found in groundwater. Prior to PL 109-58, firms using MTBE as an oxygenate had liability protection from groundwater contamination actions.

⁹ Ethanol use accounts for a growing share of the corn crop. In 2004, corn used for ethanol accounted for 11 percent of the crop. This share is projected to rise to 33 percent in 2008.

Two critical points to bear in mind from this discussion: 1) Policy support through energy legislation has been a major factor in expanding demand for corn, but it is important to recognize that Congressional actions can be revised; and 2) The increased linkage between energy markets and agriculture could continue to support crop prices if oil prices stay high, even if there are changes at some point in the future in mandates, import protection, or tax incentives provided by EISA. Alternatively, if the oil bubble bursts, crop prices could fall dramatically.

The Farm Bill

The 2008 Farm Bill provides authorization for \$307 billion to address nutrition (including food stamps), food safety, rural development, trade, research, conservation, energy, and commodity production. The Congressional Budget Office (CBO) estimates that the 2008 Farm Bill provides approximately \$7 billion per year in funding authorization for commodities and about \$5 billion per year for conservation (CBO 2008). As the authorized amounts suggest, the commodity title provides substantial incentives for crop production; however, these incentives are dwarfed by those provided by markets (Congressional Research Service 2008).

Commodity Title. Interpreting the CBO estimates requires a little background. There are numerous programs in the commodity title, but for our purposes two broad categories of 'programs' can be used. The first, direct payments, provides payments to producers based on historic commodity production. These payments are not price responsive, and are constant over all market conditions.¹⁰ The second category involves commodity payments in response to the level of market prices. These payments to producers go up when prices fall and go down when prices rise. Because of the high current and projected commodity prices, commodity payments are expected to disappear for many crops and decline sharply for others. For this reason, care needs to be taken when interpreting the CBO commodity title outlay projections. Although projected outlays decrease relative to the 2002 Act, the incentives provided for crop production have not appreciably decreased in the event that prices decline appreciably. The outlays under the 2008 legislation decrease because expected commodity prices have

¹⁰ Retired cropland, such as enrolled in the Conservation Reserve Program and the Wetland Reserve Program, is not eligible for direct payments.

increased, not because the level of support has been reduced. If projections for agricultural prices are overstated then program payments to farmers would increase and CBO cost estimates would be exceeded.¹¹

Conservation Title. The CBO estimates that the 2008 Act will provide about \$1.4 billion more annually for conservation than the 2002 Act. The conservation titles provide for: a 12.9 million CRP hectare cap; authority to annually enroll nearly 102,000 hectares into the Wetland Reserve Program; expanded funding authority for the Environmental Quality Incentive Program and Conservation Security Program; a mandate to quantify conservation effects; and a mandate to facilitate development of environmental services markets. Of these items, only the first two provide potential direct incentives for wetland restoration. The additional \$1.4 billion annual increase for the conservation title is substantial, but the additional incentives for BLH restoration are greatly exceeded by the incentives for cropping provided by current market conditions. Landowners responding only to economic stimuli will likely continue cropping their land.

THE ROLE OF CONSERVATION INCENTIVES AND ENVIRONMENTAL MARKETS

Current prices are far beyond normal levels, suggesting that as crop production responds to these prices, supplies will increase and prices will decrease. As prices decrease, the annual rental payments, cost share payments, technical assistance, and additional incentives offered for wetland restoration in the conservation title will make these relatively more financially attractive, particularly to risk adverse landowners. Even with the current high prices, some landowners, seeking to increase non-market benefits from the land, either for personal consumption or from a sense of stewardship, are restoring wetlands and enrolling in the CRP and WRP (Table 4). When commodity prices decrease, conservation uses will become more competitive on marginally profitable lands as economic motivations are reinforced by conservation program incentives providing enhanced opportunities for wetland restoration.

This discussion would be incomplete without a final word on markets in general and environmental

services markets in particular. Effective markets have repeatedly been demonstrated to be efficient in allocating scarce resources. High prices spur increased production, while low prices direct productive resources elsewhere. Because environmental services are generally not traded, markets treat these services as having low prices, directing resources away from producing environmental services. As the importance of environmental services has become understood, public policies have been developed to encourage the retention and restoration of these services. These policies have traditionally used regulation and other non-market mechanisms to generate or protect these services. Regulation can facilitate or hinder environmental service markets. Regulations that specify a desired level of environmental quality open the door for markets that would not otherwise exist, allowing that level of environmental quality to be attained efficiently. Conversely, prescriptive regulation, such as the ethanol mandates, is problematic because it precludes such markets and stifles innovation (Coase 1960).

A means to overcome countervailing public policy and market forces is the development of markets for environmental services. Developing these markets could marshal significant resources needed to restore marginally profitable agricultural lands to BLH and garner the environmental services generated by these ecosystems. The United States reengagement in international climate change negotiations, make it likely that carbon markets will emerge over the next several years. A carbon market could provide substantial additional incentive for wetland restoration by providing additional revenue and increasing landowner income from such restorations. The potential also exists for other environmental services such as nutrient cycling, hydrologic storage, and wildlife services, although these markets are further from fully emerging.

CONCLUSION

Current high crop prices discourage floodplain restoration on cropland. Enrollment in USDA wetland restoration practices has slowed considerably. If prices remain high, then conservation provisions will have a negligible effect. Interest in conservation programs will be driven solely from stewardship and other non-market motivations, which to a large extent will be overwhelmed by market incentives. As prices moderate, conservation programs can play a substantial role in restoring floodplain ecosystems by providing landowners with marginally productive cropland an opportunity to transition to a more profitable land-use. The

¹¹ The effects of commodity price supports when they exceed market prices are well documented. For a discussion see Goodwin 1993, Wu 1999, Goodwin and Smith 2003, Congressional Research Service 2008, and Economic Research Service 2008a, among others.

emergence of environmental services markets will provide increased incentives for wetlands restoration.

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